Dec 1st, 12:00 AM

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# Crop quality from 2009/2010 and grain storage management needs

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## The 2009 crop

Corn in 2009 was extremely wet and had low test weights (often 52 lb/bu and less) that did not increase significantly after drying. The situation was caused by a wet, cold growing season that was 20-25% short on heat units, followed by a cloudy, humid fall, with just enough heat to put field molds in their optimal growing conditions. This was the source of higher-than-normal damaged (moldy) kernel levels out of the field, with progressively higher risk of vomitoxin, zearalenone, and fumonisin from west to east in the Corn Belt. Mycotoxins do not go away in storage; they will show up in 2009 corn carryover. Storage molds do not normally produce toxins to the extent that field molds do, but experience is limited in extreme high-damage cases. On the plus side, tests showed that higher moisture and lower test weight by themselves did not inherently reduce ethanol yield on a dry weight basis.

Low test weight corn does not store well; 2009 corn had about 50% of the normally expected shelf life (see Table 1). In the fall we had very aggressive storage molds that created distinctly bad corn, especially when put in bunkers. This summer, the same storability problem contributed to a sudden increase in less aggressive but still problematic blue-eye mold (germ damage from Penecillium or Aspergillus glaucus fungi). Blue-eye damage showed up very suddenly at the end of July, without leading indications of heating or smell. With much of the Corn Belt getting 150-200% of normal rainfall in summer 2010, even low moisture corn was at risk, and the air conditions were such that air movement through grain did little good. Blue-eye does not create heating, just spoiled grain. Blue-eye will develop when the Allowable Storage Time is used up and the moisture-temperature is in equilibrium with 65% or greater relative humidity. Tables 2 and 3 at the end of this article show the equilibrium moisture properties of corn and soybeans; you can see that at warm temperatures, dry corn is at risk. Even corn at 13.5% moisture will have a 65% relative humidity in it when the corn is at 70 degrees.

There was a large hailstorm across north central Iowa in August 2009. This storm eliminated or damaged nearly 1,000,000 acres of grain. Mold damage in the hail area increased the level of vomitoxin and zearalenone to levels that created disruption for feed mills and ethanol plants. Toxins from either wet or dry years are going to be a continuing issue because they are concentrated in the distillers grains of ethanol plants. Ethanol accounts for 70% of corn consumption in Iowa.

Corn was also overwintered in the field in many areas.. A survey of this corn showed that toxins did NOT increase in overwintered corn, although there was some increase in discoloration by other molds. The overwintered corn ended up at 18-20% moisture, and in many cases, probably fared better than it would have had it been harvested and stored in poor conditions. Table 4 summarizes the hail and standing corn study results.

Soybeans from 2009 were very wet until mid November, when an unusually mild period occurred. This was enough to reduce moistures of soybeans in the field and in bins to below 15%. The highest moisture soybean sample we saw in the Grain Lab was 31%, which is far beyond anything most of us thought could occur.

## The 2010 crop

In 2010, conditions were better, but not as good as originally hoped. Excessive rainfall and warm nights reduced corn yields. Quality is good but not excellent; 54-56 lb/bu test weights are normal but with little field Damage. The warm, dry fall nearly eliminated artificial drying with most corn coming out of the field less than 17% moisture, and some as low as 10%. The equilibrium moisture charts below demonstrate why in some instances corn was harvested

at very low moistures. No drying means fewer broken kernels and improved storage life. However, the 2009 carryover corn will be blended over time to the extent that standards as enforced by grading practices will allow. Users should expect damage at or near contract specs.

Both corn and soybeans were harvested in warm weather Be sure to cool the grain after harvest to prevent spoilage from starting, even in the relatively drier grain this year. The dew point is a good indication of cooling potential; dew points have been in the 40s and 50s even with temperatures in the 70s and above. Low humidity air has good cooling potential as it evaporates water from grain. The normal aeration practice is given in Table 4 below. Add 1-2 cooling cycles this year because of warm harvest temperatures.

Soybeans are particularly at risk because we tend to think of them as safe for storage when they are harvested below 13 percent moisture, and therefore sometimes put them in non-aerated or poorly aerated storages. If unaerated storage must be used, only put cool, dry grain in there.

As a reminder – corn from different crop years should never be mixed in storage, as instability results. With the large amount of the poorer quality 2009 corn still in storage, grain will be blended when sold, but this should not be done before storage. Use test weight as a guide to determine which 2010 grain should be kept and which should be marketed or used quickly. Heavier corn will have better storage properties, while corn less than 54 lb/bu will have progressively poorer storage properties. With the large amount of damaged corn in storage from 2009, the market cannot accept more condition problems from 2010 corn.

On September 30 the Iowa Department of Agriculture and Land Stewardship (IDALS), as the state representative for the U.S. Food and Drug Administration, issued a statement saying that grain submerged (water over the grain) in flood waters was to be considered contaminated and therefore was not eligible for entry into food or feed markets. Ethanol is a feed market because of the dried distillers grains with solubles (DDGS). This same policy was used for stored grain submerged in 2008 by the eastern Iowa floods. The logic is that, in addition to in-field mold issues, flood waters can contain many contaminants from a wide variety of sources.

The release and accompanying public health fact sheet are posted on the Iowa Grain Quality Initiative website. The IDALS/FDA statement allowed adjusters to consider the grain of no value in the crop insurance process.

## Going forward

Production is increasing; many seed companies and users believe the trendline corn yield increase is now about 4 bu/acre/year, with some projections as high as 6 bu/acre/year. If true, on a nationwide basis, there would be 300-500 million new bushels of corn per year, which is the equivalent of 8-12 new 100 million gallon ethanol plants each year. Also there will be the need for initial storage of that amount of new grain each year. New storage costs $2-$3 per bushel (flat buildings, round bins) so the continued investment will be significant. Add to that the need for new dryers and logistical capacity. Regardless of whether ethanol or other demands use the grain, expansion of grain handling, storage and distribution seems very likely.

## Further reading

Iowa Grain Quality Initiative - www.iowagrain.org

**Table 1.** Allowable storage time for corn and soybeans. (2009 crop = 50% of table value)

| | | Maximum storage time (months) for corn and soybeans at % moisture | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grain temp. | Corn | 13% | 14% | 15% | 16% | 17% | 18% | 24% |
| | Soybean | 11% | 12% | 13% | 14% | 15% | 16% | N/A |
| 40°F | | 150 | 61 | 29 | 15 | 9.4 | 6.1 | 1.3 |
| 50°F | | 84 | 34 | 16 | 8.9 | 5.3 | 3.4 | 0.5 |
| 60°F | | 47 | 19 | 9.2 | 5.0 | 3.0 | 1.9 | 0.3 |
| 70°F | | 26 | 11 | 5.2 | 2.8 | 1.7 | 1.1 | 0.2 |
| 80°F | | 15 | 6 | 2.9 | 1.6 | 0.9 | 0.9 | 0.06 |

*Based on 0.5% maximum dry matter loss - calculated on the basis of USDA resarch at Iowa State University. Corresponds to one grade number loss: 2-3% pts in damaged seeds. Soybeans approximated at 2% lower moisture than corn.

**Table 2.** Equilibrium moisture content of corn

| | Relative humidty | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30% | 35% | 40% | 45% | 50% | 55% | 60% | 65% | 70% | 75% | 80% | 85% | 90% |
| Temp | ---------- wet basis moisture percentage ---------- | | | | | | | | | | | | |
| 35° | 11.0 | 11.6 | 12.3 | 12.9 | 13.5 | 14.2 | 14.8 | 15.6 | 16.3 | 17.2 | 18.2 | 19.5 | 21.1 |
| 40° | 10.6 | 11.3 | 11.9 | 11.9 | 13.1 | 13.8 | 14.5 | 15.2 | 16.0 | 16.9 | 17.9 | 19.1 | 20.8 |
| 45° | 10.2 | 10.9 | 11.5 | 11.5 | 12.8 | 13.5 | 14.1 | 14.9 | 15.7** | 16.6 | 17.6 | 18.8 | 20.5 |
| 50° | 9.9 | 10.6 | 11.2 | 11.2 | 12.5 | 13.1 | 13.8 | 14.6 | 15.4 | 16.3 | 17.3 | 18.6 | 20.2 |
| 55° | 9.6 | 10.2 | 10.9 | 10.9 | 12.2 | 12.8 | 13.5 | 14.3* | 15.1 | 16.0 | 17.0 | 18.3 | 20.0 |
| 60° | 9.3 | 9.9 | 10.6 | 10.6 | 11.9 | 12.6 | 13.3 | 14.0 | 14.8 | 15.7 | 16.8 | 18.1 | 19.7 |
| 65° | 9.0 | 9.7 | 10.3 | 10.3 | 11.6 | 12.3 | 13.0 | 13.8 | 14.6 | 15.5 | 16.5 | 17.8 | 19.5 |
| 70° | 8.7 | 9.4 | 10.0 | 10.0 | 11.4 | 12.0 | 12.7 | 13.5 | 14.3 | 15.3 | 16.3 | 17.6 | 19.3 |
| 75° | 8.5 | 9.1 | 9.8 | 9.8 | 11.1 | 11.8 | 12.5 | 13.3 | 14.1 | 15.0 | 16.1 | 17.4 | 19.1 |
| 80° | 8.2 | 8.9 | 9.6 | 9.6 | 10.9 | 11.6 | 12.3 | 13.1 | 13.9 | 14.8 | 15.9 | 17.2 | 18.9 |

* Average October

** Average November

**Table 3.** Equilibrium moisture content of soybeans

| | Relative humidty | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **30%** | **35%** | **40%** | **45%** | **50%** | **55%** | **60%** | **65%** | **70%** | **75%** | **80%** | **85%** | **90%** |
| **Temp** | ---------- wet basis moisture percentage ---------- | | | | | | | | | | | | |
| 35° | 6.6 | 7.5 | 8.3 | 9.1 | 9.9 | 10.8 | 11.7 | 12.6 | 13.7 | 14.8 | 16.1 | 17.7 | 19.7 |
| 40° | 6.4 | 7.3 | 8.1 | 8.9 | 9.8 | 10.6 | 11.5 | 12.5 | 13.5 | 14.6 | 16.0 | 17.5 | 19.6 |
| 45° | 6.3 | 7.1 | 8.0 | 8.8 | 9.6 | 10.5 | 11.4 | 12.3 | 13.4** | 14.5 | 15.8 | 17.4 | 19.5 |
| 50° | 6.1 | 7.0 | 7.8 | 8.6 | 9.5 | 10.3 | 11.2 | 12.2 | 13.2 | 14.4 | 15.7 | 17.3 | 19.4 |
| 55° | 5.9 | 6.8 | 7.7 | 8.5 | 9.3 | 10.2 | 11.1 | 12.1* | 13.1 | 14.2 | 15.6 | 17.2 | 19.2 |
| 60° | 5.8 | 6.7 | 7.5 | 8.3 | 9.2 | 10.1 | 11.0 | 11.9 | 13.0 | 14.1 | 15.4 | 17.0 | 19.1 |
| 65° | 5.6 | 6.5 | 7.4 | 8.2 | 9.0 | 9.9 | 10.8 | 11.8 | 12.8 | 14.0 | 15.3 | 16.9 | 19.0 |
| 70° | 5.5 | 6.4 | 7.2 | 8.1 | 8.9 | 9.8 | 10.7 | 11.7 | 12.7 | 13.9 | 15.2 | 16.8 | 18.9 |
| 75° | 5.3 | 6.2 | 7.1 | 7.9 | 8.8 | 9.7 | 10.6 | 11.5 | 12.6 | 13.7 | 15.1 | 16.7 | 18.8 |
| 80° | 5.2 | 6.1 | 6.9 | 7.8 | 8.6 | 9.5 | 10.4 | 11.4 | 12.5 | 13.6 | 15.0 | 16.6 | 18.7 |

* Average October

** Average November

**Table 4.** Hail and Standing Corn Study Results

| | **Mean ear rot severity (%) and range** | **Ear rots present** |
|---|---|---|
| Hail damage samples (n=56) | 11.8<br>(0-53.4) | Fusarium, Gibberella<br>Cladosporium, Penecillium |
| Background samples (n=27) | 3.3<br>(0-16.4) | Cladosporium<br>Fusarium, Gibberella |
| Standing corn samples (n=72)<br>(No increased toxin) | 24.0<br>(0.2-83.8) | Cladosporium<br>Fusarium, Gibberella |

**Table 5.** Aeration Practice

| | |
|---|---|
| **Phase 1: Fall cool down** | Lower grain temperatures stepwise<br>- October 40-45 F<br>- November 35-40 F<br>- December 28-35 F |
| **Phase 2: Winter maintenance** | Maintain temperatures with intermittent aeration<br>- January, February 28-35 F |
| **Phase 3: Spring holding** | Keep cold grain cold<br>- Seal fans<br>- Ventilate headspace intermittently |